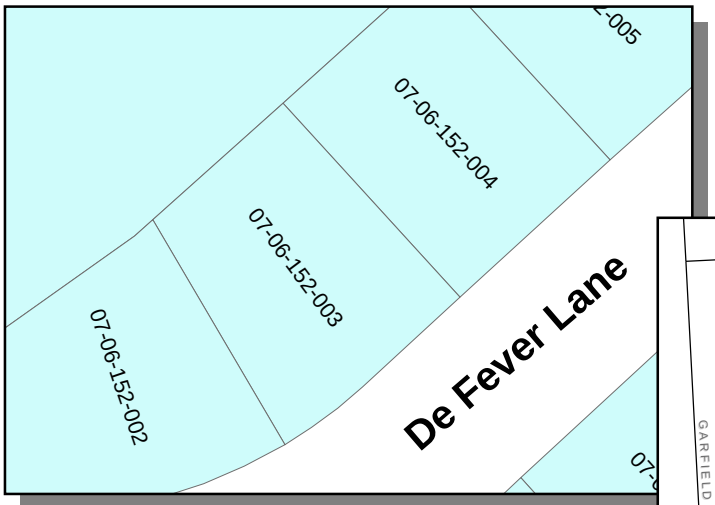
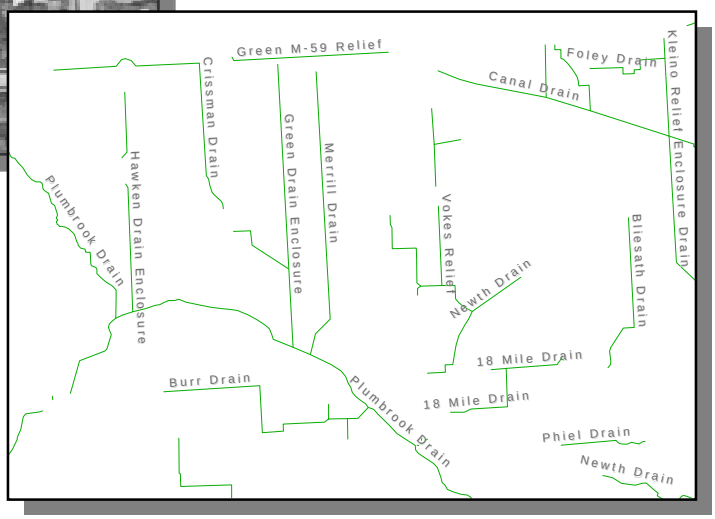
# Macomb County
# Geographic Information System

## Conceptualizing the Future of Spatial Data Use in Macomb County






GIS

MACOMB COUNTY
Department of Planning
and Economic Development

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# Macomb County
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## Conceptualizing the Future of Spatial Data Use in Macomb County

### Introduction

For decades the Macomb County Department of Planning and Economic Development has been recognized as the County's source for spatial data. This large field of data including paper maps, census information, aerial photography and economic market information has been used by staff across many different County department's and agencies, as well as, members of the private sector and the general public. In the early 1990's the Department undertook an intensive effort to computerize its operations. This effort has touched upon all aspects of the Department's operations including word-processing, desktop publishing, presentation graphics development and Geographic Information Systems (GIS). With the Department's objective of applying the latest computer technologies to its traditional tasks, staff quickly embraced GIS as a means of centralizing all of the Department's spatial data efforts under one comprehensive system.

Initially, GIS technologies were applied to 1990 census data sets. Application of these technologies resulted in on-demand map generation and statistical analysis capabilities that were in the past impossible to develop due to the large number of calculations that needed to be performed or due to the extremely labor intensive methods of manual map generation. Building upon the success of applying GIS to the census, staff identified three key areas for inclusion within the Department's developing GIS system – property line mapping, aerial photography and supporting spatial data sets

This report outlines these initiatives and describes their importance to the County. Further, this report presents a vision for building a GIS based spatial data environment which serves the needs of the Department as well as other County departments and agencies. Goals, objectives and the specialized tools critical for building a comprehensive system capable of developing, maintaining, publishing and distributing these spatial data sets are presented.

## ESRI Shop

In 1998, the Department migrated its GIS technologies to Environmental Systems Research Institute's (ESRI) ArcInfo software suite. This move was the result of many months research into the capabilities of the package and a desire to develop GIS solutions in an industry standard application which was already in place in other Counties within the region. Both Oakland and Wayne counties along with the Southeastern Michigan Council of Governments and the Wayne County Office of the Rouge River Wet Weather Demonstration Project had previously selected ESRI products and had been developing sharable data sets within the software package. The migration greatly increased the analysis and development capabilities of the Department and ensured the ability to share data with neighboring jurisdictions.

## Parcel Conversion, Digital Orthophotography and the Cadastral Mapping System

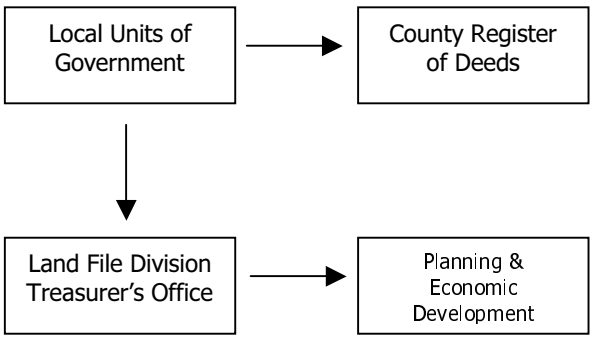
### *Cadastral Mapping History*

Historically, the Department's graphics section has functioned as the custodians of the County's cadastral maps. Originally drafted as ink on polyester film (mylar) drawings in 1973 by an outside vendor, these maps have since been maintained by draftsmen within the Department. Currently, the hard copy cadastral maps are being converted to an electronic format utilizing ESRI software.

The cadastral map set is used by many County departments and agencies to identify the physical location of property, dimensions, acreage and to determine property ownership via the Tax ID number (Sidwell number) contained on each parcel. Further, local units of government, the public, and private sector also rely heavily on these maps for the same reasons.

Traditional maintenance of the cadastral maps involves the work of the assessors within the local units of government, the Macomb County Land File division of the Treasurer's office and the graphics section staff of the Macomb County Department of Planning and Economic Development.

Figure 1 – Generalized Cadastral Mapping Workflow

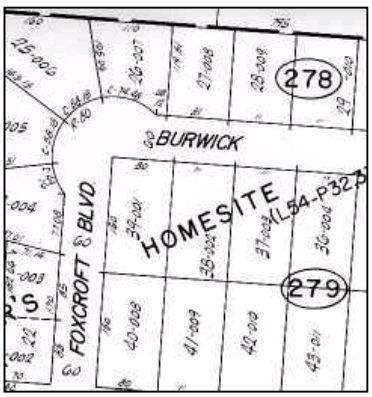



At the local unit of government's assessor's office, developers submit plat plans for new subdivisions and buyers and sellers of property submit documents detailing the transfer of property. These documents and plats are forwarded to the Macomb County Register of Deeds office where they are recorded. At the same time, a copy of the information is sent to the land file division. There the legal descriptions of the property are verified along with the parcel's Tax ID number. Once verified, the land file division draws new property lines for the parcel within their Computer Aided Design (CAD) software. The files created are then plotted and delivered to the Department of Planning and Economic Development for inking onto the County cadastral map set. Routinely updated map sheets and their corresponding aerial photography are available for retail counter sales as well as distribution to County departments/agencies and local units of government for a scheduled fee.

Figure 2 Traditional Cadastral Mapping Products

Aerial Photograph

Parcel Cadastral Map




Composite Map

*Aerial Photography History*

Traditionally, aerial photography has been obtained by the County at the beginning of each decade to correspond with the decennial census. In 1972, with the advent of the Macomb County Board of Commissioner's decision to standardize the County's parcel mapping system through a contract with the Sidwell Corporation, subdivided plats of land were converted to fit rectified aerial photography. This new system of land records management allowed parcel lines and photographs to be displayed simultaneously via light table overlay or published for sale/distribution as a composite print via ammonia/light based Ozlid reproduction machines. In the past aerial photography has been processed as tiled, D sized sheets which corresponded with a similar sized cadastral map. In total the 1990 flight resulted in 2600 aerial photo sheets and an additional 2600 cadastral sheets.

Table 1 Chronology of Macomb County Aerial Flights

| Flight Year | Flight Coverage |
|---|---|
| Spring 1964 | Entire County |
| Spring 1972 | Entire County |
| Fall 1978 | Partial Flight (High Growth Areas) |
| Spring 1980 | Entire County |
| Spring 1990 | Entire County |
| Spring 1995 | Partial Flight (High Growth Areas) |

*Parcel Conversion Program*

Beginning in January of 1998, the Department's graphics section began converting the traditional cadastral map sheets to digital files. During the process existing map sheets are scanned as raster .tiff files. These files are then used to heads-up digitize (trace) the parcel lines. Once parcels for a given sheet are traced, each individual parcel is annotated with its Tax ID (Sidwell) number which is also derived from the scanned raster .tiff drawing. Competed traced drawings are transferred from simple vector drawing files to ArcInfo format. During this conversion process topological intelligence is recorded with the parcels as each parcel's Tax ID, geometry, and other data associated with the parcel is stored as a record in a relational database. The final phase of the conversion process will utilize the forthcoming digital orthophotography (DOP) to merge each of the individual ArcInfo coverages into a seamless countywide map tiled by geographic township.

*Digital Orthophoto Program*

On June 23, 1999 the Macomb County Board of Commissioners authorized the Department of Planning and Economic Development "…to initiate a vendor selection process to acquire digital orthophotography…" and to "…report back to the Planning and Economic Development Committee (PED) with a vendor recommendation." In October of 1999, the Department returned to PED with a report recommending a project vendor. The following recommendation was approved by PED and authorized by the Board of Commissioners at their October 1999 meeting.

> "To authorize the Macomb County Department of Planning and Economic Development to execute a contract with Owen Ayres and Associates to conduct the year 2000 aerial photography flight and create digital orthophotography, road centerline file and a hydrography file at a cost not to exceed $547,615."

A contract between the vendor and County was signed in February. Aerial photography was captured in late March. Initial deliveries of product for internal QA/QC will be received by the Department in June 2000. An intensive QA/QC process will be conducted throughout the summer, fall and early winter. Final products are scheduled to be delivered by February 2001. Delivery of final imagery products will be formatted on CD-ROM, DVD, or DAT as determined by the Department at time of delivery. The following table outlines the deliverable digital image sets, quantity of images and estimated file sizes at various compression schemes.

Table 2 Actual Digital Orthophotography Deliverables

| Tiling Scheme | Quantity | Image Size | Total Storage |
|---|---|---|---|
| ¼ Mile Sections 6" Res. Uncompressed .TIF | 2016 | 72MB | 145GB |
| ¼ Mile Sections 6" Res. Compressed .SID – x12 | 2016 | 6MB | 12GB |
| Geographic Township 12" Res. Uncompressed .TIF | 14 | 3GB | 42GB |
| Geographic Township 12" Res. Compressed .SID – x12 | 14 | 250MB | 4GB |
| County Image 24" Res. Uncompressed .TIF | 1 | 20GB | 20GB |
| County Image 24" Res. Compressed .SID – x12 | 1 | 841MB | 841MB |
| **MINIMUM STORAGE REQUIRED** | | | **225GB** |

## Building a GIS Based Spatial Data Environment

*The Vision*

The Department of Planning and Economic Development has been working for a number of years to fully develop a GIS based spatial data environment. The design of this environment focuses on GIS as a spatial data set production tool for developing, maintaining and distributing information to County departments and agencies. Within such an environment, workflow designs that move data through each step of the mapping process can be developed for any existing data, new data creation, maintenance, and distribution task.

Three production workflow and distribution paths have been targeted for this effort. These paths include production and distribution of cadastral mapping data sets, production and distribution of digital orthphotography images and the production and distribution of census and other data sets that link to the cadastral maps.

*Spatial Data Workflow*

Today within the County there exist many different departments and agencies that utilize spatial data created by the Department. These spatial data sets include, but are not limited to, aerial photography, census data (both graphic and tabular), cadastral maps, road centerline coverages, hydrographic coverages, county maintained drains, community base maps, county land use, generalized zoning and many more. Further, a number of paths exist in which raw spatial data flow into the Department from other County entities, such as the Land File division of the Treasurer's Office. Spatial data flowing into the Department is merged into existing data sets or the production of new specialized data products. Traditionally, paper-mapping products have been the medium for distributing these spatial data sets, but within recent years the frequency at which data sets have been requested in electronic format has increased greatly. Conceptualizing an environment within the County where spatial data flows between producers and end users requires developing a workflow model that is comprised of four separate, but interrelated workflow subpaths. These subpaths have been defined as follows.

Table 3 Workflow Subpaths within County Spatial Data Workflow Environment

| | |
|---|---|
| *Capture:* | Capture involves collection of spatial data information from departments and agencies outside of the Department. Spatial data may be in hard (paper) or softcopy (electronic) format. |
| *Production & Maintenance:* | Production processes captured spatial data into a format that integrates with existing data sets or as a newly defined spatial data product. Maintenance perpetuates existing data sets through the editing, appending, or deletion of captured data. |
| *Publishing:* | Publishing is a means of standardizing spatial data into formats that can be accessed by end users and to assure data integrity. Often there will exist two forms of a spatial data set. The production version, which is accessible only to the staff charged with its maintenance and a published version which exists as a snapshot in time of the former and is accessible to the end users. Publishing and Maintenance cycles will vary from one spatial data set to another. These cycles are governed by the frequency of new Captured data and the need for timeliness of the data on the part of the end users. |
| *Distribution:* | Distribution is the means by which end users may access spatial data. Distribution may include single or multiple mediums (hard/soft copy) for any given spatial data set. Further, Distribution also includes the means by which the data sets are transferred to the end users. |

*Cadastral Mapping Workflow*

Goals:

- Bring the County's traditional cadastral mapping production into the realm of the County's GIS environment building a seamless countywide parcel base map.
- Electronically integrate CAD parcel data from Treasurer's Land File division into the production and maintenance efforts of Department's GIS staff.
- Build an attributed cadastral data set containing primary keys to which other County departments and agencies can relate their own external data sets.
- Develop hard/soft copy distribution system that scales to the needs, computing resources and technical abilities of all potential endusers of the data set.

Objectives:

- Acquire the critical hardware and software components necessary to support the capture, production, maintenance, publishing and distribution of the cadastral data set.

- Work in conjunction with the County's MIS department to aid County departments and agencies wishing to develop or relate existing data sets to the cadastral data set.

- Work with Land File Division to develop a standard set of operating procedures for the capture of new and changed parcel information as AutoCAD .DXF files.

- Establish queue of plotter files to facilitate automated hardcopy counter sales of cadastral map products.

- Establish standard operating procedures for the transfer of electronic data requests to CD-ROM or DAT media.

- Leverage the County's developing wide area network WAN for the distribution of the cadastral data set to select departments and agencies.

- Develop a pilot project with MIS and a selected County department or agency to provide electronic access to the cadastral data set.

- Develop a pricing schedule for product sales under the guidelines of the County's "Enhanced Access" policy.

The cadastral mapping workflow marks the center of all the Department's GIS activities and has the greatest impact on all of the County departments and agencies that have a need to display property ownership in a graphical manner. Parcel information developed by the Land File division is currently stored on the Department's file server (PED1) as AutoCAD files. This information when modified by Land File staff will be saved as AutoCAD .DXF files in a special directory structure developed by the Department staff on PED1. GIS staff will convert the resulting .DXF files into ArcInfo coverage files which will be merged

into the existing cadastral data set and aligned with the digital orthophotography. Large conversion and other processor intensive tasks will be queued as batch jobs on the Geoprocessing Server. All parcel splits, combines and new subdivision plats will become part of the cadastral data set only after they have undergone a thorough QA/QC process by both the Land File division and Department GIS staff. This process, initiated by the Land File division's existing procedures for verifying each parcels legal description, Tax ID number and coordinate geometry, will be concluded once the newly added parcels' spatial position and adherence to the cadastral data set's attribute schema are verified by Department GIS staff.

Two separate copies of the cadastral data set will reside on PED1. The first of these is referred to as the production version of the data set and the second the published version. Under this arrangement, editing permissions are granted only to the GIS staff engaged in the maintenance of the data set. The published version exists in read-only state and is the only version of the data available to the end users. Periodically, the published data set will be purged and replaced with a copy of the latest version of the production data set.

Counter sales of cadastral mapping products will be supported through the creation of ArcInfo plot files that will be queued on PED1. Plot files are predefined maps stored as binary files in the native language of a given printer or plotting device. As counter customers request hardcopy paper output of portions of the data set, clerical staff can send plot files directly to the Department's Print Server (PED2) for rapid printing without the intervention of GIS staff.

External requests for electronic copies of the cadastral data set will be distributed in ArcView shapefile format on CD-ROM or DAT. Attribute data associated with the cadastral set distributed by the Department will be limited to the basic information already publicly available on the County's hardcopy cadastral maps.

Internal distribution of the cadastral data set to County departments and agencies employs similar technologies and approaches as the other two workflows presented in the following subsections. Internal distribution is addressed in a forthcoming section entitled "Internal Distribution of Spatial Data Sets".

Figure 3 graphically depicts the cadastral mapping workflow and identifies the key players, hardware and software resources.

Figure 3

# CADASTRAL MAPPING WORKFLOW

## Land File Workgroup

**CREATION** Land File workgroup performs redline changes based upon new subdivision plats & splits/combines of existing parcels. Parcel information is passed to Planning department GIS workgroup as AutoCAD DXF export file.

## GIS Workgroup

**STEP 1: CONVERSION/MAINTENANCE** GIS workgroup converts AutoCAD DXF export file to ArcInfo coverage placing AutoCAD drawing layers into appropriate coverages. Parcel dimension and Tax ID (Sidwell number) information is transferred to coverage attribute table. New coverages are merged into master parcel fabric and aligned with Digital Orthophotography.

**STEP 2: PUBLISHING** At regular intervals, GIS workgroup converts ArcInfo coverages of the parcel layer by community to ArcView shapefiles. Shapefiles are stored on PED3 Intranet Map Server. Community coverages and orthophotos are also transferred to ArcInfo plot files and stored on PED1 Department File Server.

## Distribution

**DISTRIBUTION** ArcInfo Plot files qued on PED1 Department File Server are available for counter sales of line drawings, orthophotos and composites. Clerical staff can release plot files to electrostatic plotter. ArcView shapefiles are available to County departments via Intranet Map server and ArcExplorer HTML application. Electronic requests for parcel products will be burned to CD-ROM, DVD-RAM or transferred to DAT tape.

*Digital Orthophoto Imagery Workflow*

Goals:

- Obtain digital orthophotography imagery from contracted vendor at specified scales, resolutions and compression factors.
- Electronically integrate orthophotography imagery with cadastral data set.
- Develop hard/soft copy distribution system that scales to the needs, computing resources and technical abilities of all potential end users of the orthophotography imagery set.

Objectives:

- Acquire the critical hardware and software components necessary to support storage, publishing and distribution of the orthophotography imagery set.
- Establish queue of plotter files to facilitate automated hardcopy counter sales of orthophoto imagery products.
- Establish standard operating procedures for the transfer of electronic data requests to CD-ROM or DAT media.
- Investigate viewer software that will encrypt images stored on CD-ROMs to restrict the copying of publicly sold imagery thereby preserving the County's copyright and revenue stream.
- Leverage the County's developing wide area network WAN for the distribution of the digital orthophoto imagery set to select departments and agencies.
- Develop a pilot project with MIS and a selected County department or agency to provide electronic access to the orthophotography imagery set.
- Develop a pricing schedule for product sales under the guidelines of the County's "Enhanced Access" policy.

The digital orthophotography workflow originates with the County's selected photogrametric firm Owens, Ayres and Associates, Inc. Black and white photography collected in late March will be matched to the surface of the earth within ±3 feet of its true spatial position. Draft copies of the digital orthophotography imagery will be transferred to the County on CD-ROMs, DVD or DAT for QA/QC analysis. Any problems found with the imagery will be annotated as an overlaid ArcView shapefile. Shapefiles will be transferred back to the vendor via the vendor's FTP site. Road centerline/address, hydrographic and CLEMIS related data sets will also be created from the imagery and transferred via FTP to the Department for QA/QC processing. Once the Department has approved the imagery and associated data sets, entire community data sets by geographic township will be delivered on CD-ROM, DVD or DAT. Initial estimates for delivery of the entire imagery data set as outlined in table 2 place the total file size for the orthophotography at 214 GB. If delivered on CD-ROM, the entire County data set will span a disk set of 329 CDs.

Counter sales of orthophoto imagery products will be supported through the creation of ArcInfo plot files that will be queued on PED1. Plot files are predefined maps stored as binary files in the native language of a given printer or plotting device. As counter customers request hardcopy paper output of portions of the imagery set, clerical staff can send plot files directly to the Department's Print Server (PED2) for rapid printing without the intervention of GIS staff.

External requests for electronic copies of the orthophoto imagery set will be distributed in an encrypted and compressed raster format on CD-ROM or DAT. A public domain viewer program will be supplied that permits users to view, scale and print the images, but restricts the copying of the information.

Internal distribution of the orthophoto imagery set to County departments and agencies employs similar technologies and approaches as the other two workflows presented in this report. Internal distribution is addressed in a forthcoming section entitled "Internal Distribution of Spatial Data Sets".

Figure 4 graphically depicts the digital orthophoto imagery workflow and identifies the key players, hardware and software resources.

Figure

# DIGITAL ORTHOPHOTO WORKFLOW

## Digital Orthophoto Vendor

**CREATION** Digital Orthopoto Vendor, Owen, Ayres and Associates will develop digital orthophotography for the County in tiling, resampling and compression schemes as outlined in the Department s Digital Orthophoto RFP and as presented in table

## GIS Workgroup

**STEP 1: PRODUCTION/MAINTENANCE** GIS workgroup can create additional tiling and compression schemes as needed utili ing Li ard Tech Software, Inc s. MrSID geospatial image compression publishing software. These highly intensive tasks will be performed on Department s Geoprocessing Server.

**STEP 2: PUBLISHING** GIS workgroup transfers newly created compressed imagery in MrSID format to predefined storage locations on Department s digital orthophoto imagery storage server (PED3). ArcInfo plot files are created to support counter sales of orthophotography images.

## Distribution

**DISTRIBUTION** ArcInfo Plot files qued on PED1 Department File Server are available for counter sales of orthophotos. Clerical staff can release plot files to electrostatic plotter. PEG files of orthophoto imagery are available to County departments via Intranet Map server and ArcExplorer HTML application. Electronic requests for orthophoto imagery products will be burned to CD-ROM, DVD-RAM or transferred to DAT tape.

*Supporting Data Set Workflow*

Goals:

- Standardize workflow procedures for production and maintenance of County road centerline/address data set.
- Integrate 2000 Census data with cadastral data set.
- Standardize workflow procedures for production and maintenance of Macomb County CLEMIS data sets.
- Integrate all existing spatial data sets with cadastral data set and orthophotography imagery set.
- Develop hard/soft copy distribution system that scales to the needs, computing resources and technical abilities of all potential end users of the data set.

Objectives:

- Acquire the critical hardware and software components necessary to support the capture, production, maintenance, publishing and distribution of supporting spatial data sets.
- Establish standard operating procedures for the transfer of electronic data requests to CD-ROM or DAT media.
- Leverage the County's developing wide area network WAN for the distribution of spatial data sets to select departments and agencies.
- Develop a pilot project with MIS and a selected County department of agency to provide electronic access to select supporting spatial data sets.
- Develop a pricing schedule for product sales under the guidelines of the County's "Enhanced Access" policy.

Supporting spatial data sets are developed by the Department's GIS staff from data collected from internal and external sources. Examples of these data include tabular and graphical census information, data relevant to economic development efforts, land use data, and the Sheriff's CLEMIS data set. The majority of these data sets are designed for internal use by the Department and other County departments and agencies. Only a few of these spatial data sets are developed for sale to the public or distribution to external governmental agencies. Spatial data sets developed under this workflow path usually are created to support a particular program, answer a set of policy questions, or provide supporting materials for analyzing specific problems.

External requests for electronic copies of select supporting spatial data sets will be distributed in ArcView shapefile format on CD-ROM or DAT.

Internal distribution of select supporting spatial data sets to County departments and agencies employs similar technologies and approaches as the other two workflows presented in this report. Internal distribution is addressed in a forthcoming section entitled "Internal Distribution of Spatial Data Sets".

Figure 5 graphically depicts the supporting spatial data set workflow and identifies the key players, hardware and software resources.

Figure

# S PPORTING SPATIAL DATA SET WORKFLOW

## GIS Workgroup

**STEP 1: CAPTURE** GIS workgroup or Professional Departrment staff identify the source data materials needed for developing a new spatial data set. These data may originate from internal or external soft/hard copy sources.

**STEP 2: PRODUCTION/MAINTENANCE** GIS workgroup complies captured data and links it to existing or new spatial data sets. Depending upon the complexity and the si e of the captured data sets involved and the number of GIS workgroup staff assigned to a pro ect and the intensity of the calculations required, spatial data set compilation is performed on the users local machine will be offloaded to the Department s Geoprocessing Server.

**STEP : ANAL SIS** GIS workgroup apply new and existing spatial data sets within the ESRI software environment to create output products to support assigned tasks. In some cases new spatial data sets will be created. These new data sets may be retained for future use and stored on the Department s File Server (PED1).

**STEP : PUBLISHING** GIS workgroup transfers newly created supporting data sets to predefined storage locations on Department s file server (PED1) as either ArcInfo coverage or ArcView shapefile format. ArcInfo plot files may be created to support counter sales of select supporting spatial data sets.

## Distribution

**DISTRIBUTION** ArcInfo Plot files qued on PED1 Department File Server are available for counter sales of select supporting spatial data sets. Clerical staff can release plot files to select output devices. Select supporting spatial data sets are available to County departments via Intranet Map server and ArcExplorer HTML application. Electronic requests for select supporting spatial data sets will be burned to CD-ROM, DVD-RAM or DAT

*Internal Distribution of Spatial Data Sets*

Goals:

- Leverage existing/developing County WAN to distribute spatial data sets to select County departments and agencies.
- Deploy an Intranet based solution for spatial data distribution that has a single point of administration, single point of spatial data set storage, utilizes a minimal slice of available bandwidth, requires no client setup and which incurs no startup costs to County department and agency endusers.
- Develop a three tiered system of data access that scales with user need, available resources, and technical ability.

Objectives:

- Acquire the critical hardware and software components necessary to support the distribution of spatial data sets across the County's existing/developing WAN.
- Deploy ESRI's MapObjects Internet Map Server (MOIMS) running on WindowsNT Internet Information Server (IIS.)
- Deploy ESRI's ArcExplorer HTML ActiveX or Java based user interface as a webpage running on Department's IntraNet Mapping Server (PED3).
- Determine which of the Department's spatial data sets will be available to selected endusers.
- Develop Departmental Intranet mapping website that provides endusers with a means of accessing spatial data sets.

- Develop a pilot project with MIS and a selected County department or agency to provide Intranet access to the Department's spatial data sets.

- Develop a minimal list of County departments and agencies that have a business use for the Department's spatial data sets.

- Develop a schedule with MIS for rollout to other select County departments' and agencies' endusers.

- Provide orientation sessions for endusers.

The advent of the County's emerging WAN offers an excellent solution for the distribution of spatial data sets to select County departments and agencies. Coupled with established Intranet map distribution solutions, the County's WAN can be utilized to serve extremely large spatial data and imagery sets to a wide range of endusers. This approach is ideal since it delivers small slices of the spatial data and imagery sets as either compressed GIF of JPEG images to a client web browser. As a user pans, zooms, or turns layers of the viewed map on or off, the host application simply sends an updated GIF or JPEG to the client. Most maps and images in a system designed in this manner will be transmitted as compressed images less than 75k per transaction.

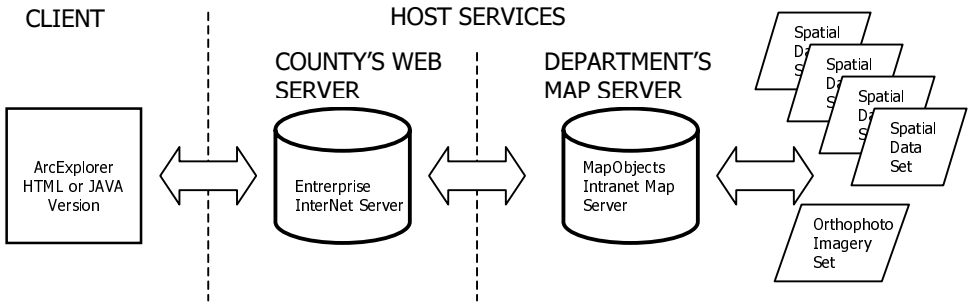
The application suite selected for distributing the Department's spatial data sets is ESRI's Internet Mapping Solution. This product is comprised of the following two separate components.

- MapObjects Intranet Map Server (IMS)
- ArcExplorer

MapObjects IMS supports Web-based distribution of spatial data and imagery sets. MapObjects IMS supports both Windows and UNIX-based Web servers. The Web server communicates with the Map server running MapObjects IMS applications. MapObjects IMS applications operate on Windows 95/98 or Windows NT In this environment MapObjects IMS acts as the map server to the Web server. The Web server handles Intranet traffic and MapObjects IMS with its map server component handles map requests and dispatches. In any deployment scenario, the Web server and the MapObjects IMS can be run on separate boxes/operating systems or coexist on a single NT Server.

MapObjects IMS uses a three-tier architecture to distribute spatial data sets. Figure 6 illustrates how the components fit together.

Figure 6 Three-tiered Distribution Architecture




In developing a distribution solution for spatial data sets it is important to assess the environment of the enterprise the solution is designed to serve. In the case of Macomb County departments and agencies, this distribution design was examined from both the client and host sides of the system.

On the client side, Microsoft Internet Explorer or Netscape Navigator is the client application used to transact with the host services. This is accomplished through either a HTML or JAVA implementation of ESRI's ArcExplorer software. ArcExplorer offers a freely distributable mapping application running within a Web browsing application. This provides endusers with a point and click mapping environment similar in look and feel to the products provided by the online services MapQuest or MapsOnline. With this application users can select spatial data sets to view, pan, overlay, zoom, print, save tabular query results, or cut and paste tabular data and maps to other windows applications.

On the host side, this solution offers a single point of administration since ArcExplorer is implemented as an HTML or JAVA application residing on the Web server. Endusers selected to access the Departments spatial data sets are simply given a URL address to the Department's/County's Intranet mapping website. No additional software needs to be loaded on the client side other than providing the clients operating system with the proper IP address of the Intranet's Domain Name Server (DNS).